HERE'S THE "POOP" ON BOMBING

FOR PILOTS ONLY!

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WHY YOU ARE HERE

I. The bombing of the Army Air Forces in the combat zones can be improved. A small reduction of the circular error in a combat group means tremendous savings in lives and equipment. For instance: A combat group that has been bombing with an average error of 400 feet is assigned a target 500 x 300 feet and is to bomb it from 20,000 feet. With the circular error of 400 feet it would take 50 ships carrying 100 two ton bombs to get ten hits. (The bomb size and the number of hits required is given to the group operations officer by intelligence.) Now by a reduction of one-fourth in the circular error, which can be done very easily with a little increased training of this kind, we can cut in half the number of ships required for the above problem. In other words by reducing the circular error by one-fourth you can double the striking power of the group.

II. It is the objective of this program to give the added amount of training to reduce the circular error that one-fourth required to double the striking power of Pilot-Bombardier teams.

III. What the course consists of:

1 hour	- ALA - Airspeed, Level, Altitude
1 hour	- Bombsight and operation
4 hours	- Actual trainer time with sight
1 hour	-- Round table discussion and exam
1 hour	- C-1 Pilot theory including Walt Disney film)
1 hour	- Actual C-1 adjustment
5 hours	- Bomb approach - day
	1st hour - P.D.I. exercises and rate turns
	2nd and 3rd hours - Manuel dry runs
	4th and 5th hours - Auto pilot dry runs
14 hours	Total

FIRST HOUR
BOMB PILOT APPROACH INSTRUCTION THEORY

I. The requirements of the ideal bombing run:

1. A - The Air speed must remain constant for the duration of the run.

2. L - The flight altitude of the ship must be controlled so that the verticle axis of the plane remains perpendicular to the earth's surface at the time the level is given.

3. A - A given altitude must be maintained for the duration of the run.

II. The trajectory of the bomb:

A. 1. The normal path of the bomb as seen in a vacuum.

2. The normal path of the bomb under actual conditions in the air.

B. 1. The trail envolved in the bombing problem.

a. It's relative position in the bombing triangle.

b. It's importance for accurate bombing.

c. The distance behind the plane.

2. The bomb falls along the heading of the plane.

3. Cross trail; crabbing the ship upwind so that the bomb will fall down wind into the target.

III. Actual time of fall:

1. Ballistic Coefficient:

This is similar to a bullet fired from a machine gun. Since the bomb also is streamlined so that it will have a given penetrating power in the air, the actual time of fall depends on this to the nth degree. The actual time of fall is computed by a formula and used in the Norden Bombsight.

5300 ÷ Actual time of fall = Disc Speed

IV. The Dropping Angle:

The dropping angle is solved by the bombsight. It can be worked out mathematically and pre-determined. This is the point in space where the bomb should be released if the target is to be demolished. The ultimate objective of all Bombardiers is to receive enough co-ordination from the crew members on the actual combat run to set up this dropping angle precisely. This then is the basis for precision bombing.

V. The Three set Factors in Bombing With the Norden Bombsight:

1. Trail.

Trail depends upon the indicated air speed which the pilot makes good on the run.

2. The Dropping Angle.

The dropping angle is adjusted by synchronization of the cross hair and is set up when the cross hair remains stationary on the ground. (This is, for the most part, preset in combat and will remain so for that given run.)

3. Actual Time of Fall.

The accuracy of the actual time of fall set in the sight is wholly dependent upon the skill of the pilot in maintaining the given altitude while on the bombing run.

Note: Combining these three all important factors:- Air speed, Level and Altitude, we arrive at the name "ALA" which is the basis for all precision coordination today.

VI. The Error - ALA

1. Air Speed:

These simple rules apply throughout.

If the air speed is too fast, we will hit short of the target.
If the air speed is too slow, the bomb will fall over.
The higher we go, the greater the error will be.

2. Level:

If the error in dropping angle resulting from an incorrect level tends to enlarge the angle used, the bomb will fall short of the target. On the other hand, if the dropping angle is made smaller, the bomb will fall over. This also is an error that tends to increase with altitude.

3. Altitude:

In precision bombing, if the altitude to be flown is exceeded, the bomb will tend to fall over, and if the pilot flies lower that the altitude given, the bomb will fall short. This error is just the opposite of air speed and level. The higher we go, the smaller the error, the lower we go, the greater the error.

VII. Art of P.D.I. Correction:

1. Purpose of P.D.I. :

To indicate how far and in which direction the ship must be crabbed into the wind to make good the desired course on the bombing run.

2. Operation:

Electronically activated through gyro impulse (connected directly to the bombsight).

3. Location:

Located directly in front of the pilot, mounted on the pilot's instrument panel.

4. Application:

a. Since the bombsight only provides for 18 degrees of stability in pitch and roll, it is imperative that no banks be in excess to 18 degrees when on the run. Therefore a shallow turnmmust be executed.

b. When the bombardier turns the inside course knob on the sight the P.D.I. is displaced either to the left or to the right. If a long, slow, smooth correction is made with no interruption but with a steady movement, the pilot can set up a rate of turn that will keep the P.D.I. almost centered. When the P.D.I. needle finally comes back to the point the Pilot will gracefully roll out of the coordinated turn. If efficiently accomplisned this will enable the Pilot and Bombardier to accurately "Kill" 30 degrees of drift and fly a course almost within one-tenth of one degree.

2nd HOUR
PROCEDURE

I. Switch On:

1. Turn stabilizer switch on.
2. After five minutes to allow the stabilizer to warm up, turn all sight switches on.

II. Zero Sight:

1. Secondary clutch is manually held in center with the left hand.
2. The sight is turned until the drift scale reads zero. This is done by taking the course knobs in the right hand and moving the sight in either direction.

III. Swing On:

1. Still holding the secondary, grasp the course knobs and sight over the cross hair bar. Swing the sight until the target is in line with the bar.

IV. Uncage:

1. Grasp caging knob with fingers of right hand and pull upward until gyro is free.

V. Clutch In:

1. Engage Bombsight clutch.

VI. Kill Course:

1. Put fore and aft crosshair on target with outside knob.
2. Stop apparent motion of hair by a long smooth correction [redacted], then put it on with the outside knob.

VII. Level:

1. Level bubbles by pushing in and turning on the large part of the leveling knob. Make small corrections. Turn knob the way you wish the bubble to go.

VIII. Put it on:

1. Use outside knob to put fore and aft crosshair back on target.

IX. Trigger Up:

1. Hold trigger up with a pinching motion of the thumb and fore finger of the left hand.

X. Motor On.

1. As rate hair crosses the target turn on telescope motor.

XI. Kill Rate:

1. Place lateral crosshair on target with outside knob.

2. Stop apparent motion of hair with inside knob.

XII. Cage:

1. Push caging knob back down.

XIII. Motor Off:

1. Turn telescope motor off.

XIV. Unclutch the bombsight clutch.

XV. Unclutch the optic clutch.

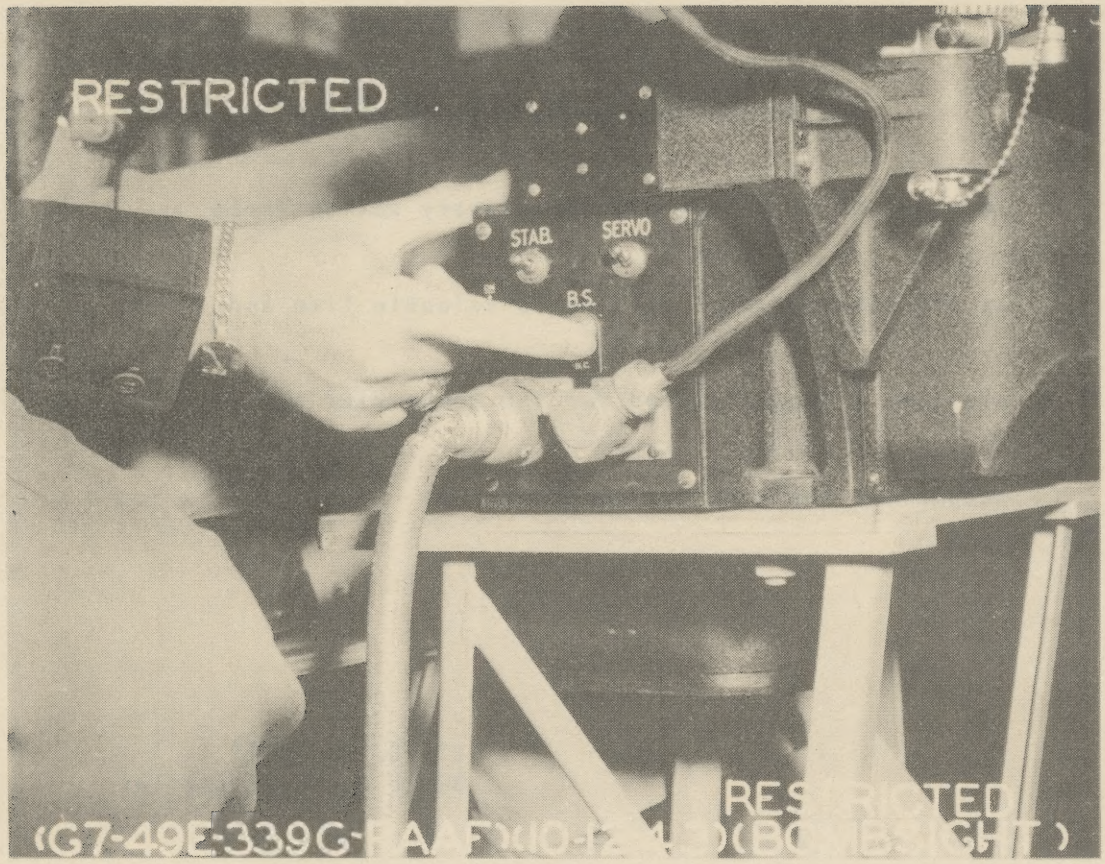
XVI. Roll Back:

1. Roll indices back and clutch in to prepare for next run.

The following procedure is suggested in order to eliminate all unnecessary action while on the bombing run. This saves valuable time and provides a longer period for the Bombardier to accomplish the required computations.

LT. C. E. ROWEN
314th Group Bombardier

SWITCH ON:



Stabilizer switch on let 5 minute delay before turning on rest of switches.

Servo, B.S. & P.D.I.

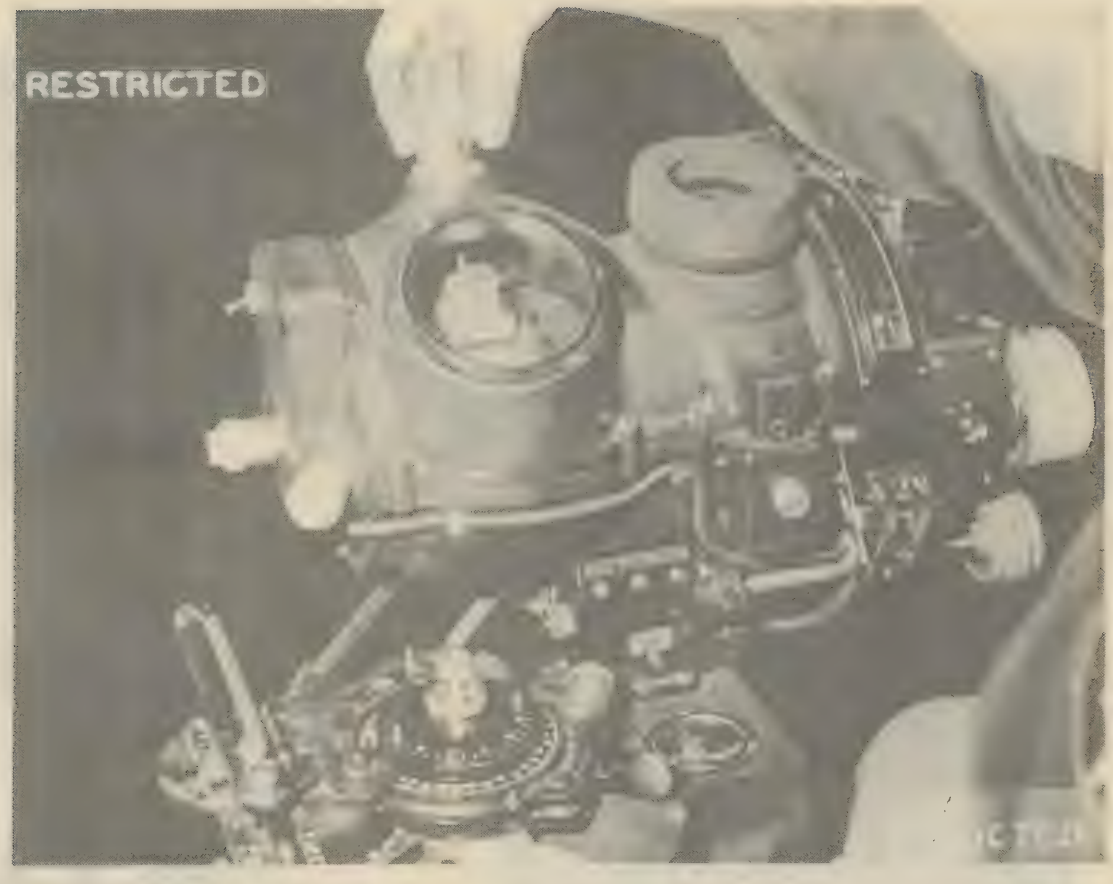
ZERO SIGHT

Three places - Drift Scale, P.D.I. thru Auto Pilot Clutch and Directional Arm.

SWING ON

Swing on sighting over trail plate for approximate sighting by holding Auto Pilot clutch and moving sight by gripping Course Knobs.

UNCAGE



Uncage Gyro with left hand or right hand - convenient

CLUTCH IN B-S C-1
CENTER AUTO-PILOT C-1 MANUALLY

Clutch in B.S. clutch holding auto-pilot clutch

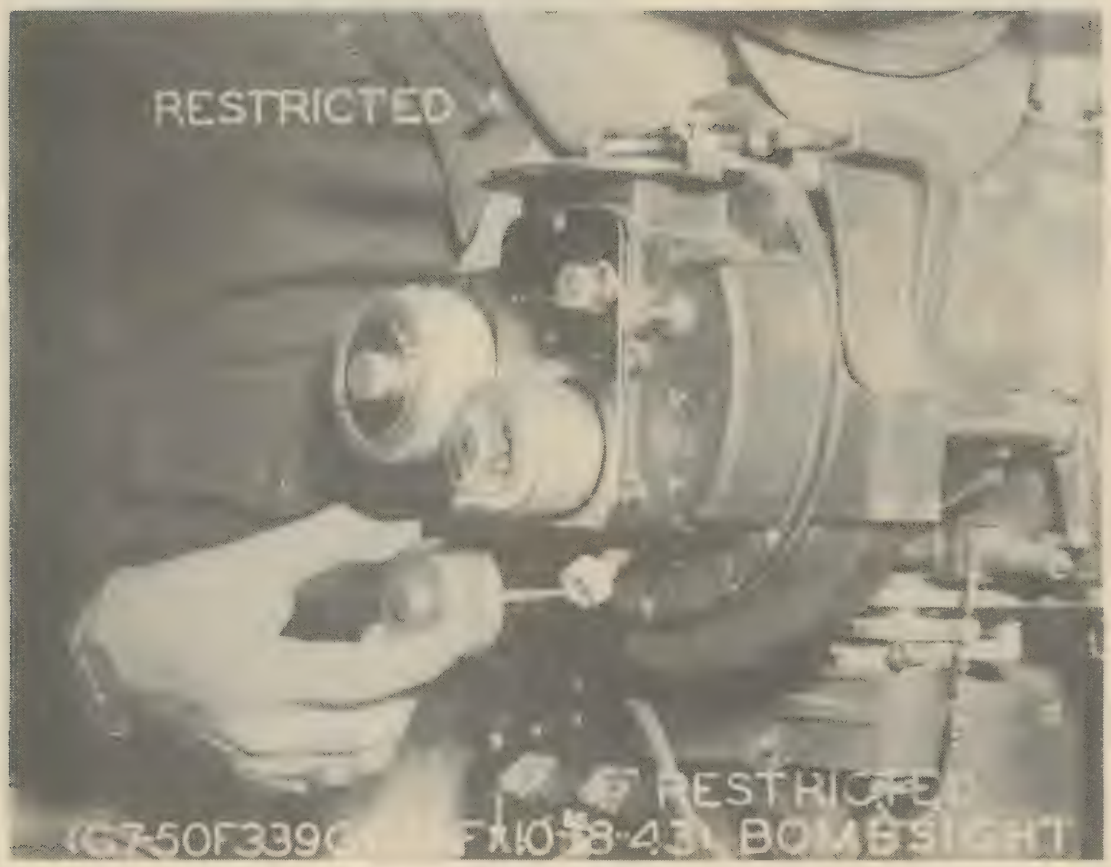
KILL COURSE!

Kill course with a smooth, slow correction [redacted]
then put it on with the outside knob.

LEVEL

After course is killed, level - determine a point by reference to allow enough time to kill rate.

PUT IT ON

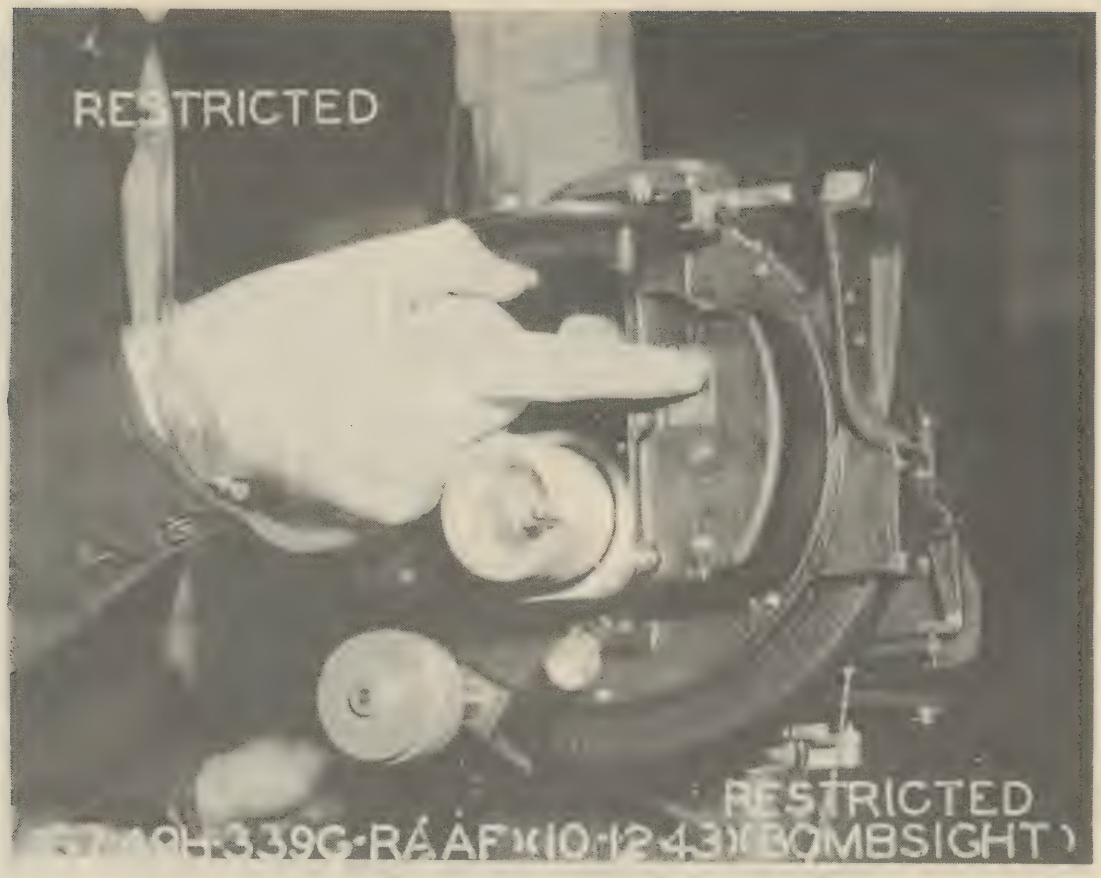


After level, use outside course knob to put course hair back on target.

TRIGGER UP

Hold trigger all the way up, do not apply too much pressure to avoid possible precission.

MOTOR ON



After trigger, reach over with right hand and turn on Telescope Switch.

RATE - KILL

Kill rate - Outside knob for displacement - Inside to stop motion single grip.

BOMBS AWAY CAGE GYRO

MOTOR OFF

UNCLUTCH B-S CLUTCH

TELESCOPE CLUTCH DISENGAGED

ROLL BACK AND CLUTCH IN